Pair background in BeamCal

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DESY

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Outline

- Setting the scene
- Compare, for TDR 1 TeV, TDR 500 GeV and RDR 500 GeV beam parameters:
  - Total number of hits in BeamCal
  - Radial energy deposition
  - Longitudinal energy deposition
  - Energy deposition fluctuations
  - Cluster reconstruction efficiency
- Summary

Introduction

- Samples:
  - 20 BX of pairs simulated for the 1TeV TRD beam parameters:
    - Waisty_opt_Jan2012_1000GeV_B1b_runX_waisty_190
  - 7 BX for 500 GeV TDR:
    - Waisty_opt_Jan2012_500GeV_runX_waisty_250
  - 1877 BX for 500 GeV RDR:
    - /grid/ilc/mc-2008_2/simulated/ILD_00/pair_bkgs_nominalparams_cms500
- Mokka: ilcsoft-v01-13-05, Mokka-07-07-p06
- From the Mokka steering file:
  - TDR
    - Mokka/init/detectorModel ILD_O1_v02
    - /Mokka/init/pairParticlesPerEvent 100
    - /Mokka/init/TPCCut 0 keV
    - /Mokka/init/rangeCut 0.1 mm
  - RDR
    - Mokka/init/detectorModel ILD_00fw
    - /Mokka/init/pairParticlesPerEvent 1000
    - /Mokka/init/TPCCut 0.01 MeV
   - /Mokka/init/rangeCut 0.2 mm

Beam Parameters

Incoherent pair backgrounds are critically dependent on the IP beam parameters.

	500 GeV RDR	500 GeV TDR	1 TeV TDR
Collision rate (Hz)	5	5	4
Bunch population (x 10^{10})	2	2	1.74
Number of bunches	2625	1312	2450
RMS bunch length (mm)	0.3	0.3	0.225
Horizontal emittance (mm x mrad)	10	10	10
Vertical emittance (mm x mrad)	0.040	0.035	0.030
Horizontal beta function (mm)	20	11	11
Vertical beta function (no TF) (mm)	0.40	0.48	0.23
Luminosity (x 10^{34}/cm²/s)	2.0	1.8	4.9
Number of pairs / BX (x 10^3)	100	139	382.6
Total energy / BX (TeV)	200		

Total Number of Hits in BeamCal
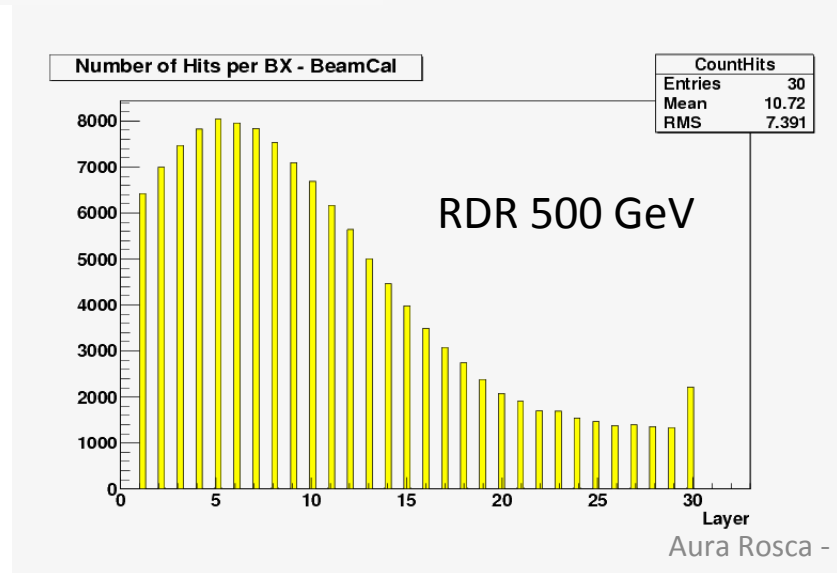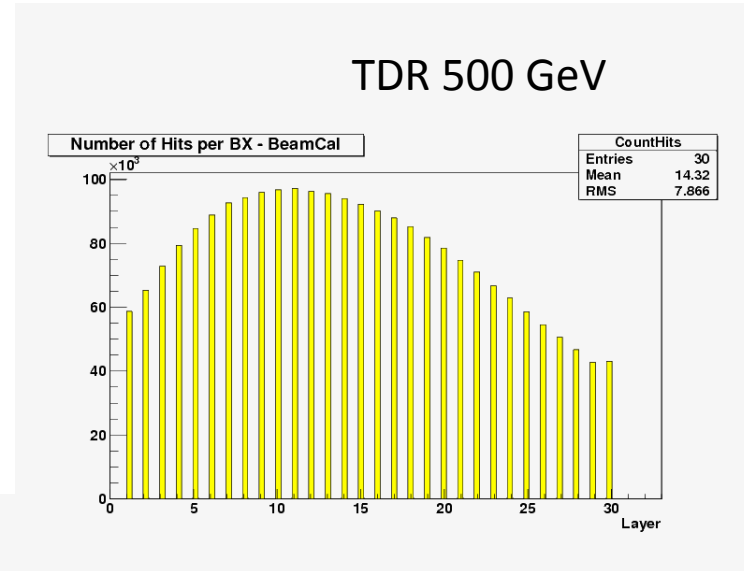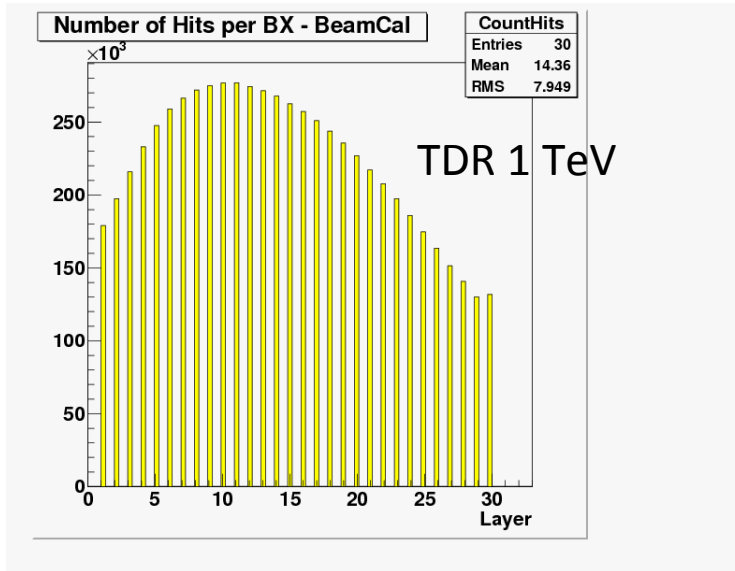
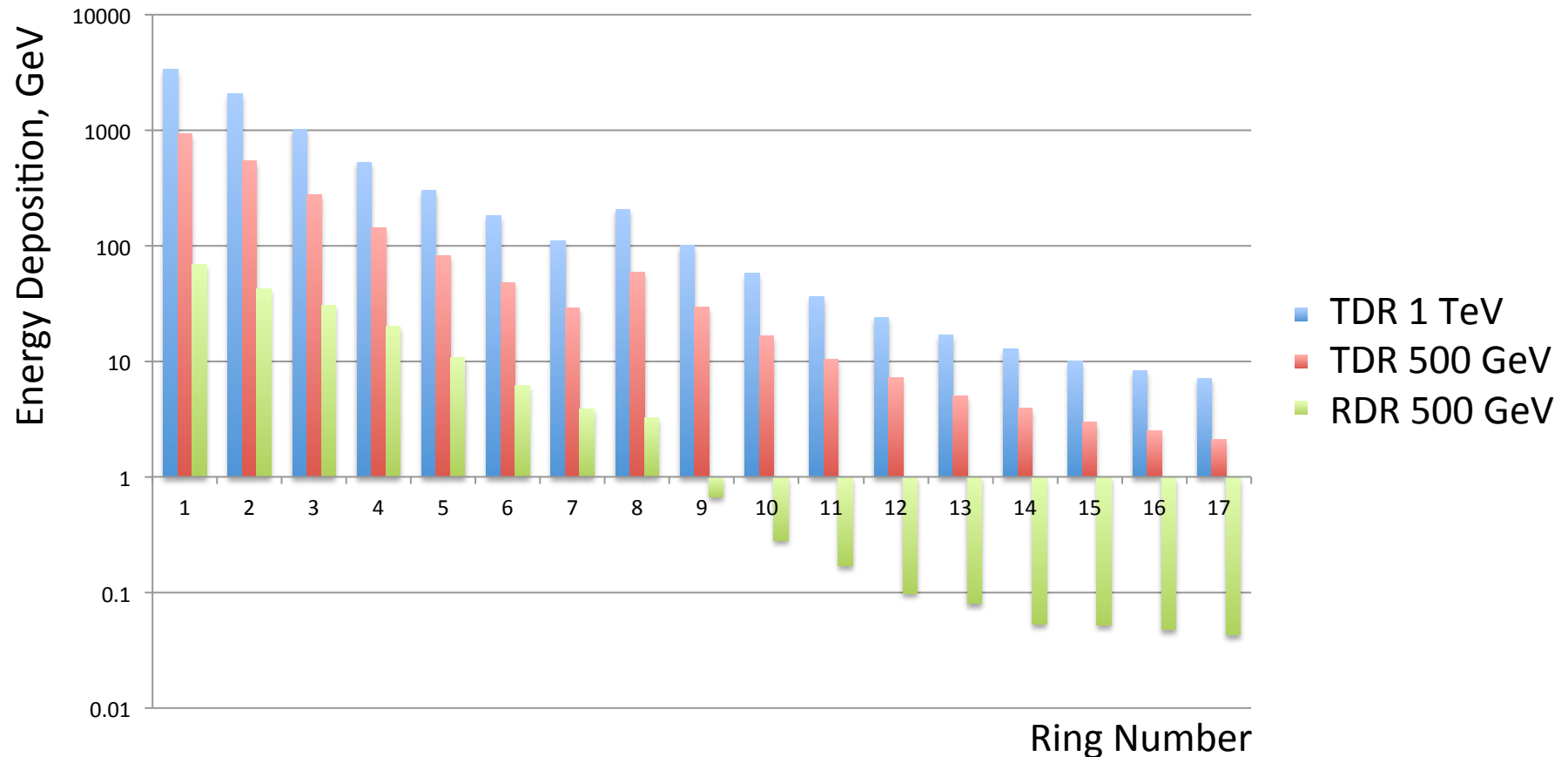# Radial Energy Deposition
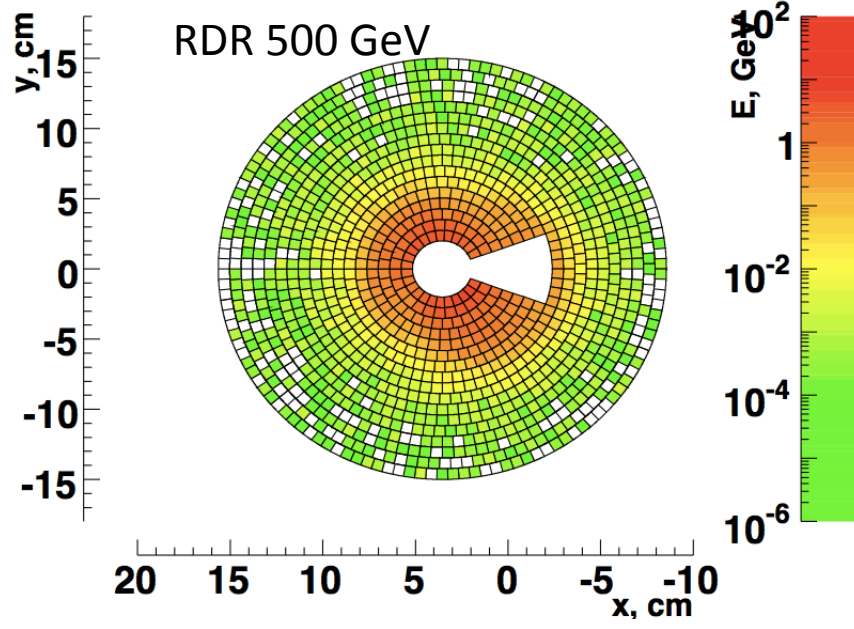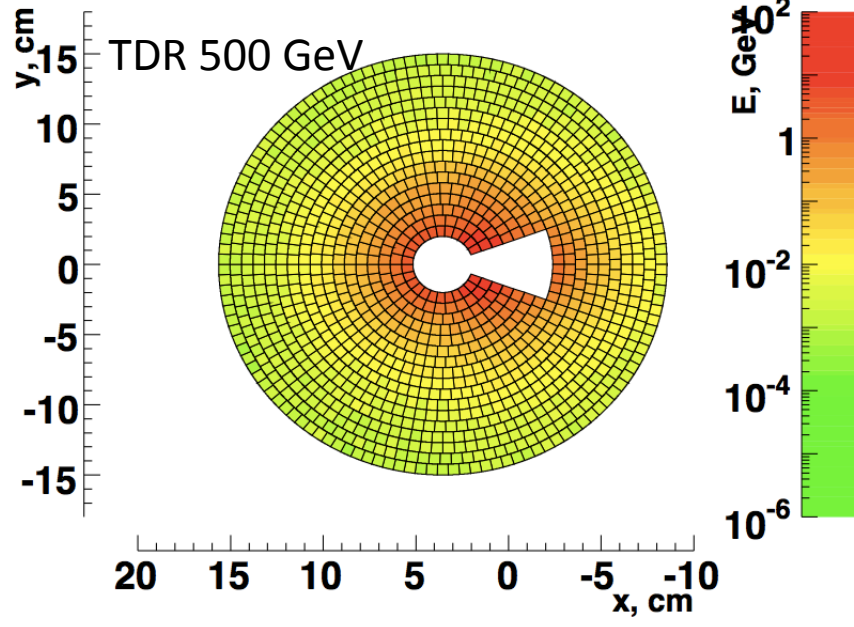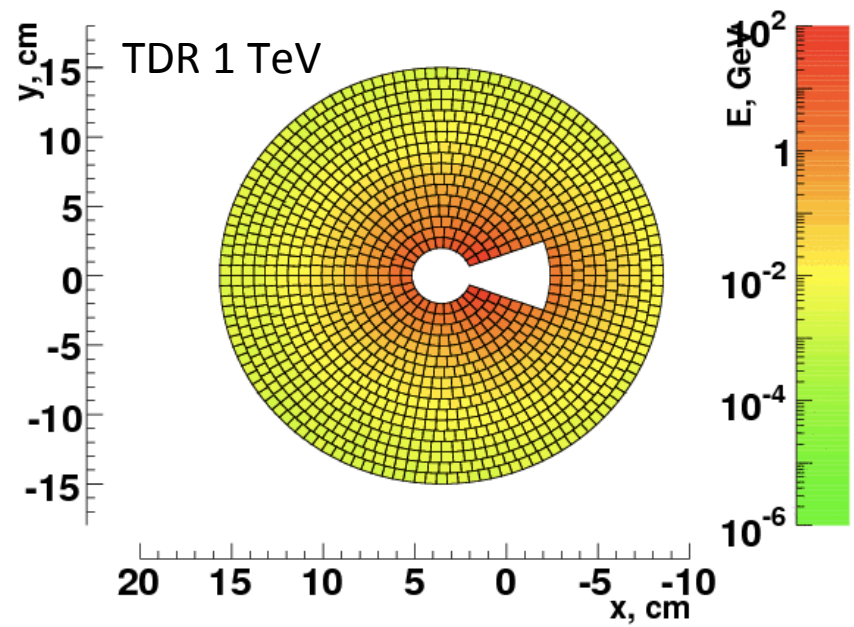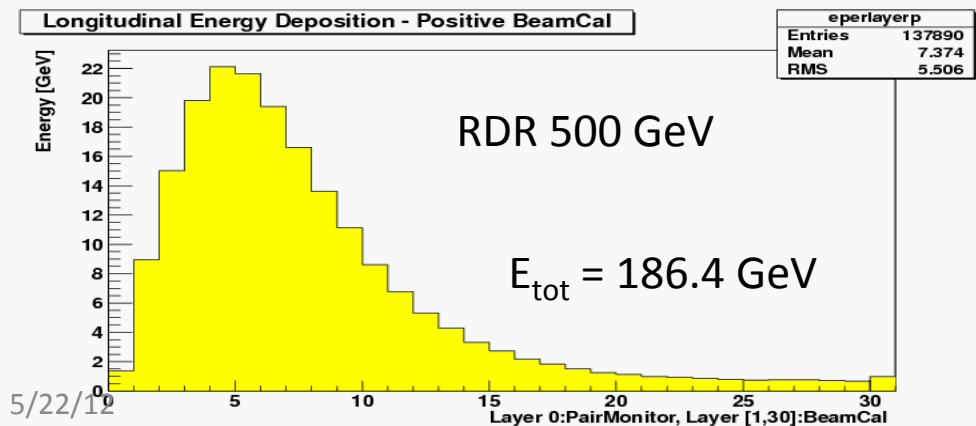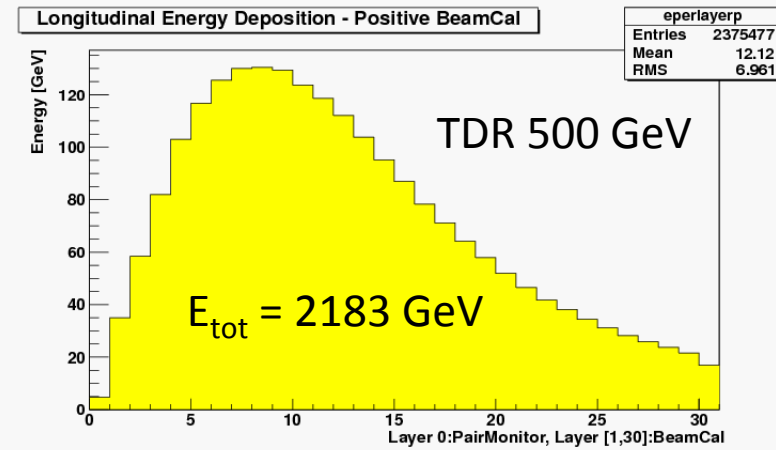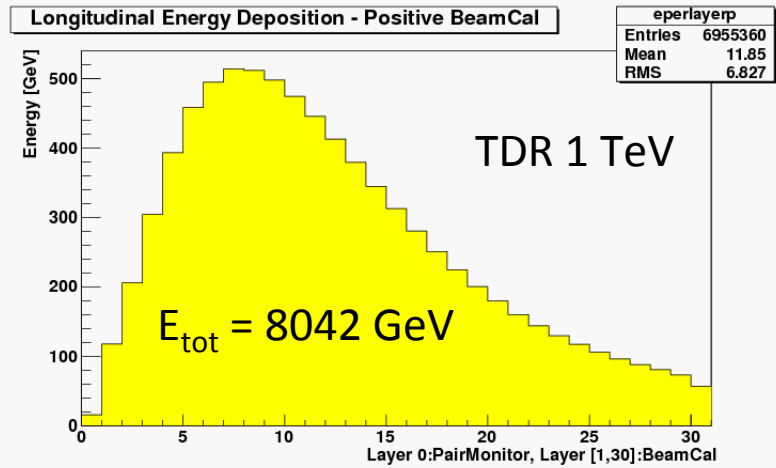

One BeamCal, energy deposition/ 8mm x 8mm, per BX

Radial Energy Deposition

1 TeV TDR ~ 40 x 500 GeV RDR energy deposition

500 GeV TDR ~ 10 x 500 GeV RDR

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Longitudinal Energy Deposition

TDR 1 TeV

E_{tot} = 8042 GeV

TDR 500 GeV

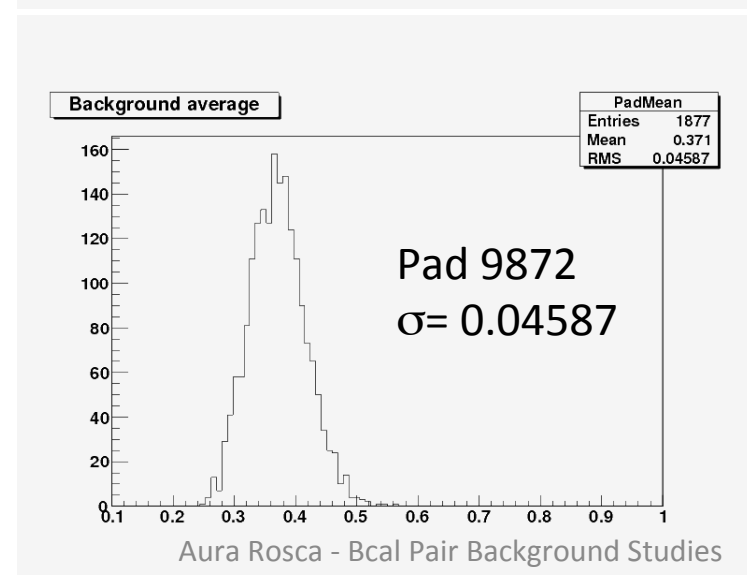E_{tot} = 2183 GeV
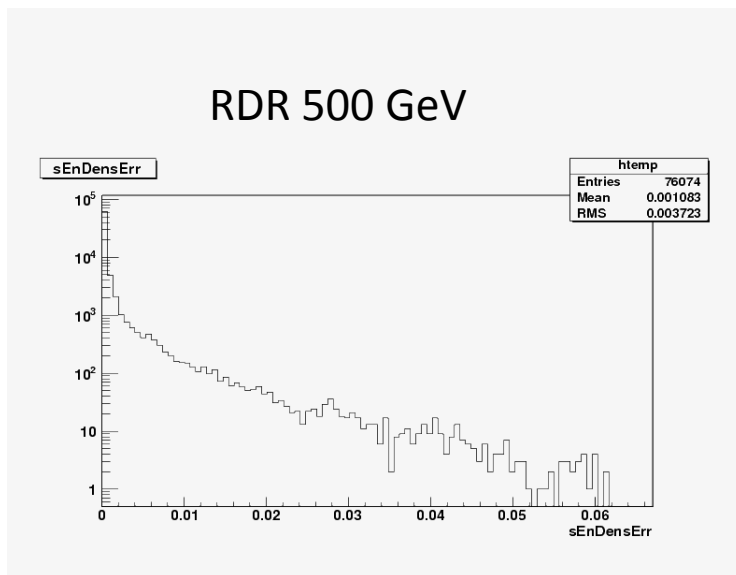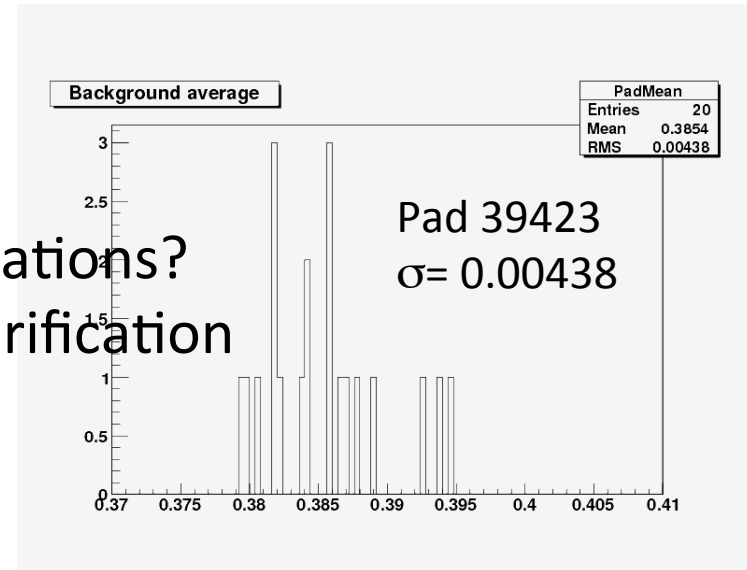

RDR 500 GeV

E_{tot} = 186.4 GeV

Pairs are harder for
the TDR beam parameters.

Energy Deposition Fluctuations

TDR 1 TeV
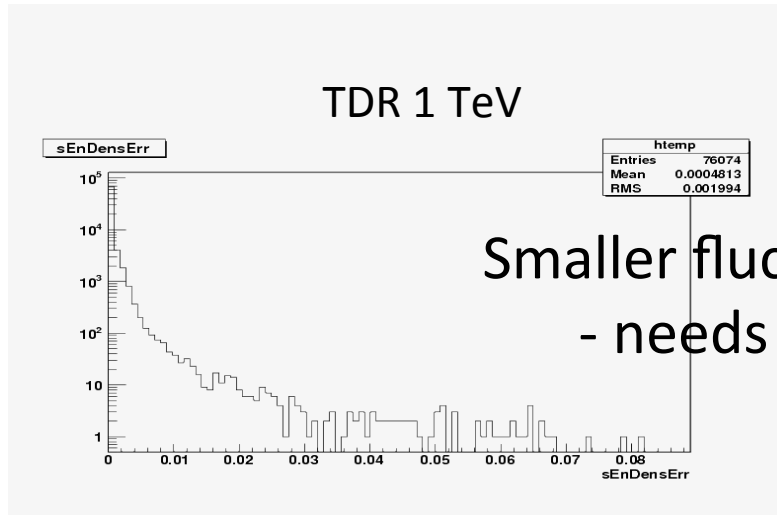
Smaller fluctuations?
- needs verification

Pad 39423
$\sigma= 0.00438$

RDR 500 GeV

Pad 9872
$\sigma= 0.04587$

Overview of Reconstruction Algorithm

Read Background Map

Smear Energy

Select Pads with $E_{pad} > 1\sigma$

Build Towers

Build Clusters

Accept Cluster Calculate E, x,y,z

En_{max}

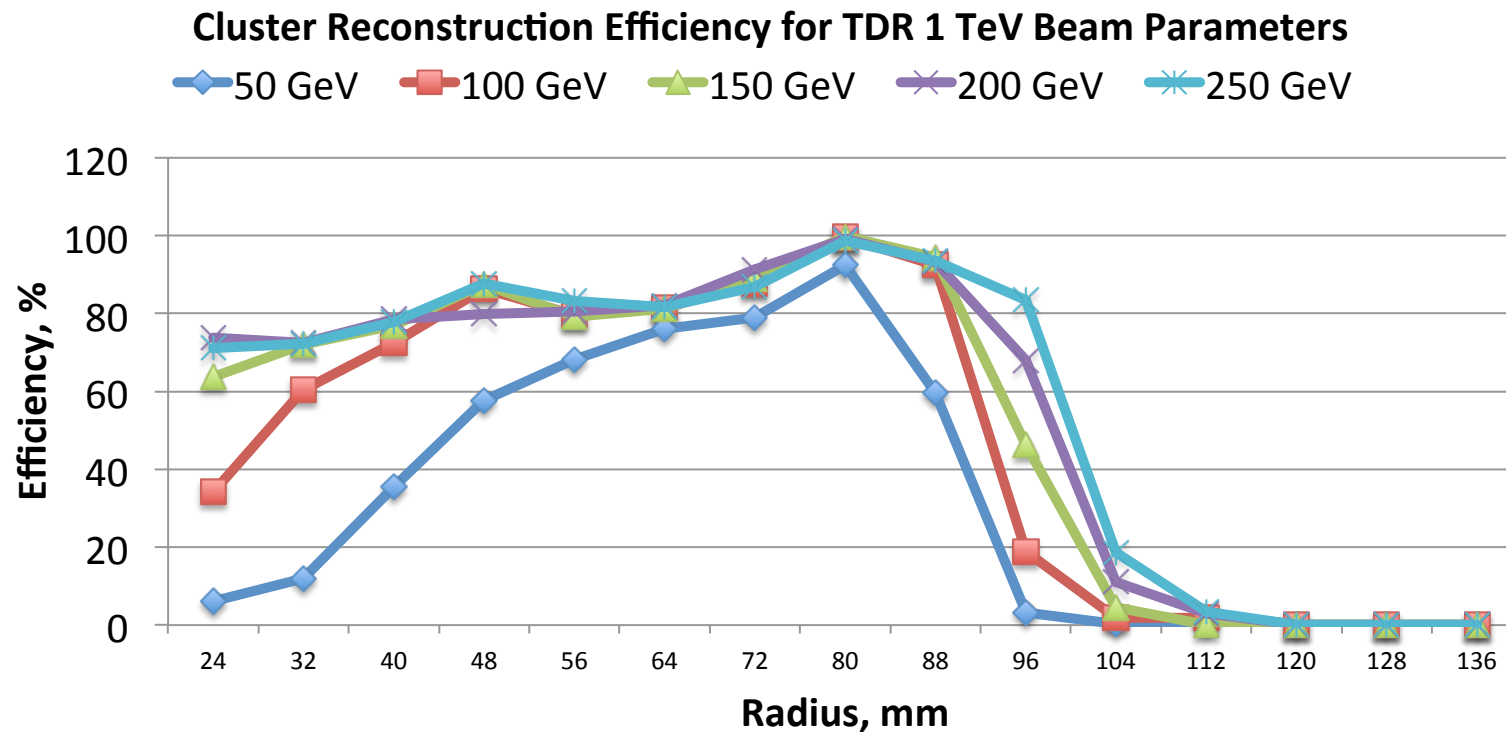Neighbouring towers of lower energy added to the cluster

$E^{tower}_n > 90\%\ En_{max}$

En_{max}
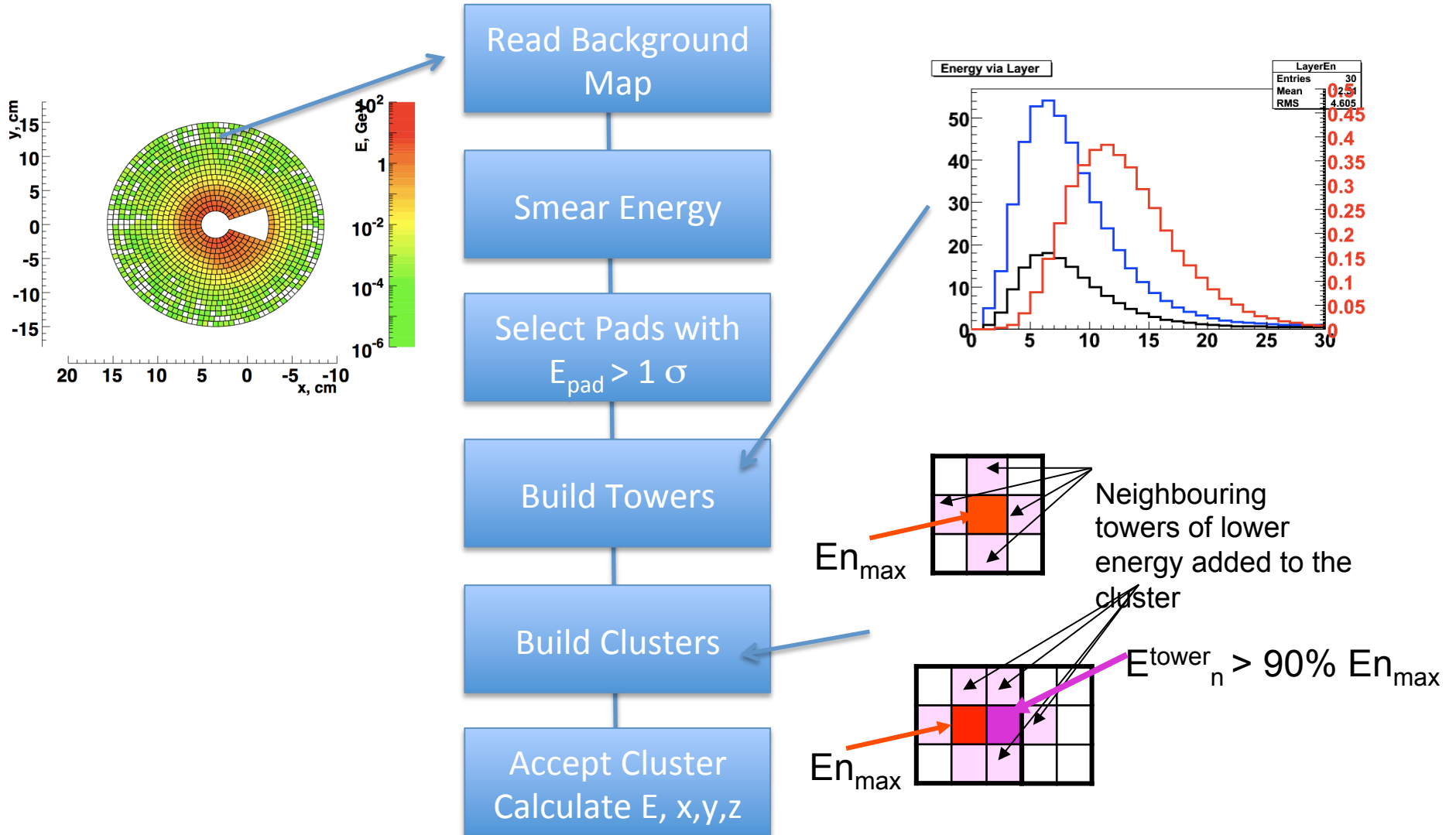
Reconstruction Efficiency

Single electrons, with energies 50 GeV, 100 GeV, 150 GeV, 200 GeV and 250 GeV, $\phi \in [0, 2\pi]$, $\theta \in [0.0067, 0.038]$

Cluster Reconstruction Efficiency for TDR 1 TeV Beam Parameters

Summary

- Energy deposition in BeamCal from pair backgrounds was studied with the latest beam parameters for 1 TeV and 500 GeV, and compared to the RDR beam settings.

- Very large deposition in BeamCal with respect to the RDR beam settings, its impact needs to be better understood.